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ABSTRACT

This guide explores the contributions that parents and teachers can make to enhance energy choice decisions that affect the design and operation of educational facilities. It also examines how making the right choice can create better learning environments. The guide reveals how schools have turned energy improvements into powerful teaching tools; how design guidelines help create high-performance school buildings; how smart schools incorporate energy features into the curriculum; and how smart energy decisions benefit schools, communities, and the environment. It further shows how much money schools can save by making the right energy choices, and it establishes the link between daylighting and improved test scores. (GR)

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Energy-Smart Building Choices

ED 461 982

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How parents and teachers are helping to create better environments for learning

EF 006 057

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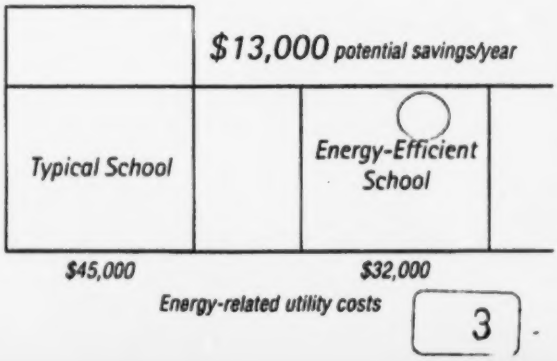
Smart Energy Choices Save Money, Create Better Learning Environments

School districts around the country are finding that smart energy choices can help them save money and provide healthier, more effective learning environments. By incorporating energy improvements into their construction or renovation plans, schools can significantly reduce their energy consumption and costs. These savings can then be redirected to educational needs such as additional teachers, instructional materials, or new computers.

Many of the same improvements that help to lower a school's energy consumption also create better places to teach and learn, with better lighting, temperature control, acoustics, and air quality. In fact, recent research reveals a strong connection between the use of daylighting in classrooms and student attendance and performance.

Energy improvements can also have a positive impact on student health and comfort. Children can't concentrate if their classrooms are too stuffy or noisy. Students with asthma are likely to miss school if indoor air quality is poor. Simple energy design strategies can improve these conditions, creating a healthier, more comfortable environment for students as well as teachers.

How much can you save?



A typical 450-student elementary school today pays over $45,000 annually for energy-related utilities. Incorporating energy-efficient design improvements could save that school over $13,000 annually, enough to purchase 13 computers or hundreds of books each year.

Schools Turn Energy Improvements into Powerful Teaching Tools

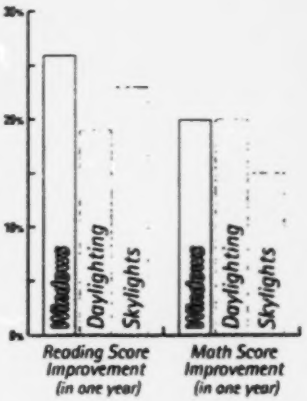
To maximize the educational benefits of their energy improvements, many schools are incorporating the energy features right into their curriculum–providing students with dynamic, hands-on opportunities for learning. Photovoltaic systems that are wired directly to displays and equipment in the science lab can help students learn first-hand about the concepts of solar energy and the conversion of sunlight to electricity.

On a smaller scale, just making your school's energy features visible to students creates an opportunity for learning. Exposing parts of the school's mechanical system, for example, enables teachers to explain how the system works. Buildings that teach offer students an intriguing, interactive way to learn about relevant topics like energy and the environment.

Input from teachers early in the design process helps to ensure that energy features are incorporated in a way that optimizes the learning experience. Teachers can explain their current curriculum and teaching procedures to the design team and discuss how the energy features could be incorporated into the curriculum for maximum effect.

Incorporating renewable energy options like daylighting, passive solar, solar hot water and space heating, solar absorption cooling, wind, and photovoltaic systems helps students learn first-hand about these options and the importance of energy efficiency. Rainwater catchment strategies teach students about water conservation. Even simple improvements like retaining or planting native trees and plants on the school site and incorporating outside teaching courtyards offer important educational benefits.

Daylighting Linked to Improved Test Scores



A 1999 study by energy consulting firm Heschong Mahone Group revealed a correlation between the use of daylighting and improved student performance. In the Capistrano school district in California, students in classrooms featuring daylighting strategies, large windows, or a well-designed skylight performed 19 to 26 percent better on standardized reading tests than students in classrooms without these features. Capistrano students performed 15 to 20 percent better on standardized math tests.

Photo: Courtesy of D&R International

Students at Bluffsview Elementary School in Worthington, Ohio, are learning about solar energy by monitoring their school's photovoltaic system. Computer links allow students to monitor the amount of power the solar panels create compared to the amount of energy their building consumes.

Roy Lee Walker School Features Built-in Teaching Tools

At Roy Lee Walker Elementary School in McKinney, Texas, features like daylighting, solar domestic hot water heating, energy recovery systems, and rainwater collection are designed not only to save energy and conserve water, but also to expose students to energy and environmental concepts.

The heat pump and solar systems at Roy Lee Walker Elementary School in McKinney, Texas, are designed to be easily seen and monitored by students.

Design Guidelines Help Create High-Performance School Buildings

A host of interrelated considerations—from site design to transportation issues—factor into the creation of a "high-performance" school. To effectively integrate energy-saving strategies, these options must be evaluated together from a whole-building perspective early in the design process.

To do this, your school district will likely want to form a team of key players from the community and school to work in collaboration with your design team. The design team must have expertise in integrating energy and environmental considerations into school designs. Inputs from all of these stakeholders factor into good functional design and ensure the long-term success of your decisions.

The following list provides basic information about 10 key elements to consider when designing a high-performance school building. Your school district can include these elements in your Request for Qualifications (RFQ) or Request for Proposals (RFP) for design professionals. Once a design team is selected, comprehensive design guidelines available through the U.S. Department of Energy's EnergySmart Schools campaign can provide your team with detailed information on the following strategies.

Site Design

Orienting the building to maximize solar access boosts the effectiveness of daylighting strategies, reducing the need for electrical lighting as well as heating and cooling loads. Designing the site to reduce or eliminate vehicular travel to the school helps to reduce fuel usage and emissions, improving the air quality in and around the school. Water requirements can be reduced by incorporating natural vegetation in the site design.

Daylighting and Windows

Increased use of daylighting helps to reduce electric lighting usage, and avoiding the heat generated by lighting fixtures helps schools use less conditioned air for cooling. Reductions in the heating and cooling loads due to daylighting strategies often enable designers to downsize the heating, ventilation, and air conditioning (HVAC) system, reducing the initial cost of equipment. High-performance windows with low-e glazing also help to minimize heat gain in warmer months and heat loss in colder months.

Energy-Efficient Building Envelope

Increased insulation in the walls and ceiling helps to reduce heat loss and improve comfort. Light-colored exterior walls and white roofs help to reduce cooling loads. These factors also contribute to reducing the size and cost of the HVAC system needed.

Renewable Energy Systems

Use of solar electric and wind technologies in conjunction with battery storage can provide security lighting, emergency power supply, or a source of steady power for computers or other sensitive equipment. It can also contribute to reduced energy costs, depending on the size of the system installed.

Lighting and Electrical Systems

Use of controls in daylit spaces can automatically reduce or increase light levels as needed. Occupancy sensors automatically turn off lights in unoccupied spaces. These options increase construction costs slightly, but pay back that increase in less than one year through energy cost savings.

Mechanical and Ventilation Systems

Using the whole-building approach, school designers can factor in energy-saving choices that reduce heating and cooling loads, and downsize the HVAC system needed. A smaller system reduces the initial cost of equipment as well as long-term operating costs. Computerized energy analysis programs can further improve the energy efficiency of the equipment installed.

Environmentally Sensitive Building Products and Systems

Indoor air quality can be improved by eliminating or minimizing:

- Volatile organic compounds (VOCs) in paints, carpet, and adhesives
- Formaldehyde in plywood, particleboard, composite doors, and cabinets

Water Conservation

Rainwater collection systems incorporated into a school design can provide water for toilet flushing and irrigation. The increase in construction costs is offset by longer-term reductions in water costs as well as the overall cost of energy used to deliver and process water.

Recycling Systems and Waste Management

Strategies to reduce the amount of landfill waste require contractors to recycle appropriate construction waste material. Once the building is constructed, schools can involve students in comprehensive recycling efforts.

Transportation

Incorporating natural gas, biodiesel, methanol, or solar electric buses into a district's existing vehicle fleet helps to reduce fuel costs and harmful emissions. Lower fuel costs contribute to reduced operating and maintenance costs.

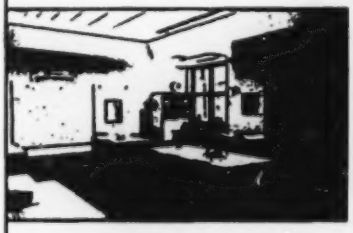
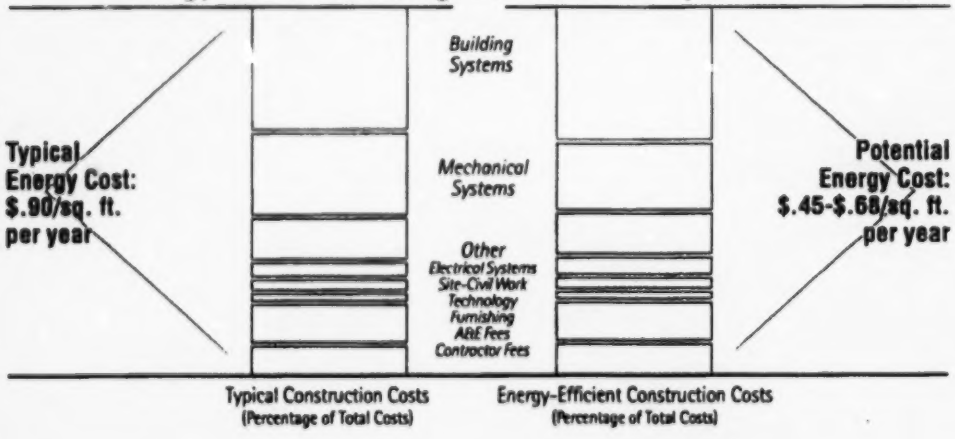


Photo: Robert Flynn

The design for Durant Road Middle School in Raleigh, North Carolina, incorporated an extensive daylighting strategy, contributing to annual energy cost savings of $77,000, record attendance rates, and improved test scores.

Energy-Efficient Buildings Don't Necessarily Cost More



Construction cost trade-offs often enable building designers to incorporate energy-efficient features without a large increase in building costs. Incorporating daylighting features, for example, may increase the percentage of construction budget typically designated for building systems. However, the resulting load reductions enable designers to specify a smaller HVAC system, decreasing the percentage of construction costs needed for mechanical systems.

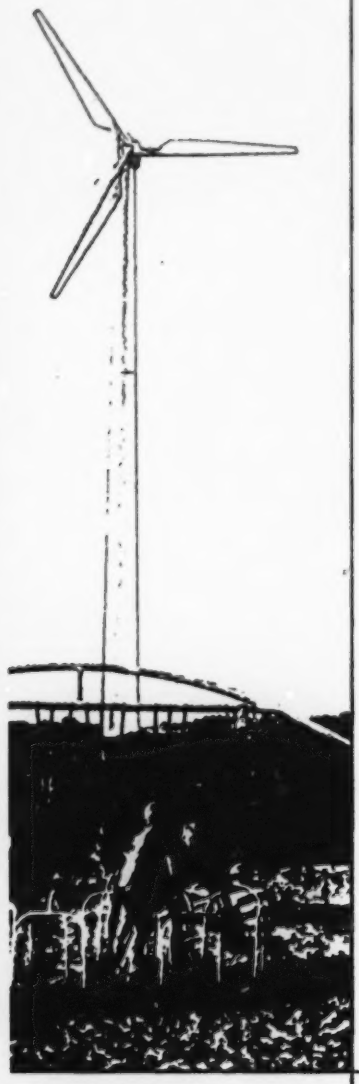


Photo: American Wind Energy Association

By installing a wind turbine, Spirit Lake Elementary School in Spirit Lake, Iowa, is not only saving money and helping the environment, it is also teaching a new generation of decision-makers about more environmentally friendly, energy-efficient alternatives.

Smart Schools Incorporate Energy Features into Curriculum

Students at Bluffsview Elementary School in Worthington, Ohio, are learning about solar energy by monitoring their school's photovoltaic system. Computer links allow students to monitor the amount of power the solar panels create compared to the amount of energy their building consumes, and to generate charts that visualize the building's energy supply and demand.

At the Spirit Lake Elementary School in Spirit Lake, Iowa, students use their wind energy website to study the environmental benefits of the wind power generated at their school. Their wind turbine has been integrated into the district's curriculum, and interactive lessons are available on the website's curriculum page. The Spirit Lake wind turbine provides nearly all of the electrical needs for the elementary school building.

More and more school districts are using their buildings' energy features to provide dynamic, hands-on educational tools for their students. By incorporating energy-efficient technologies into the curriculum, students learn first-hand about important issues like energy efficiency, renewable energy options, and the environment.

Smart Energy Decisions Help Schools, Communities, and the Environment

Implementing energy-saving features in school designs is a win-win strategy for students and teachers, as well as for the community and the environment. Energy features save money, improve the learning environment, and provide dynamic, interactive tools to teach and learn about energy concepts. Taxpayers benefit from optimized use of tax dollars, and communities reap cleaner air and more efficient water use. Schools that reduce their energy consumption help to reduce the environmental impact of power generation. They also teach the next generation of decision-makers about the importance of making energy-efficient and environmentally sound decisions for the future.

Getting Started

If incorporating smart energy choices makes sense for your school district, the EnergySmart Schools campaign can help you get started. The campaign is administered through the Rebuild America program, a national DOE initiative to improve energy use in buildings. This means that if your school is part of a Rebuild America community partnership, you're already reaping the benefits of EnergySmart Schools. In fact, community representatives in your area probably use the names interchangeably.

Rebuild America and the EnergySmart Schools campaign offer free technical help and training, as well as easy-to-use teaching materials that relate to educational standards. For more information, visit the EnergySmart Schools website at www.eren.doe.gov/energysmartschools or call DOE's energy hotline at 1-800-DOE-3732 to have a Rebuild America representative contact you.

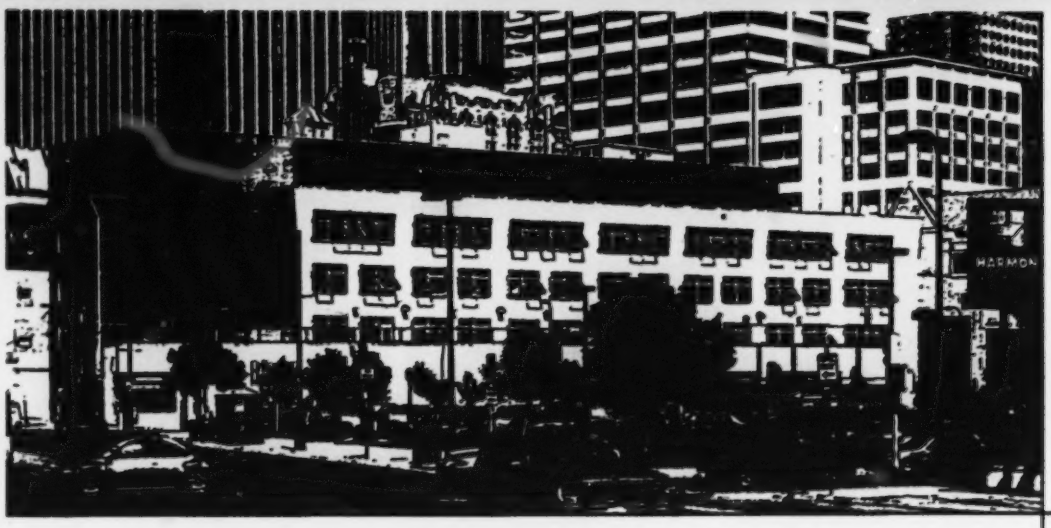


Photo: Peter Karze

The Interdistrict Downtown School in Minneapolis, Minnesota, features a solar wall heating system that saves the school $5,600 per year in energy bills. The school uses the solar heating system to introduce students to renewable energy principles.

For helpful resources or more information:

Call DOE's energy hotline: 1-800-DOE-3732

- Ask a question about saving energy in your school or request information about the EnergySmart Schools campaign. You may want to inquire about the availability of the following EnergySmart Schools resources.

Publications and videotapes

- High-Performance Design Guidelines for new schools and major renovations in seven climate zones
- Portable Classroom Guidelines
- Designing Smarter Schools, a 30-minute videotape that originally aired on the CNBC television network
- EnergySmart Solutions for America's Schools, a 10-minute videotape produced by the Department of Energy
- Educational CD-ROM featuring teaching and learning materials

Services

- Technical assistance
- Regional peer exchange forums
- State-based forums for school decision-makers
- Financing workshops
- Technology workshops

Visit the EnergySmart Schools website

- Learn more about the campaign
- Find practical guidance for improving energy use in schools
- Tap into resources for teaching and learning about energy

You may also wish to investigate other DOE programs or campaigns of value to schools: Clean Cities, a program aimed at helping communities adopt alternatively fueled vehicles and buses; the Million Solar Roofs Initiative, which helps schools and other organizations employ solar energy technologies; and the State Energy Program, a DOE program that provides grants to schools and other organizations and is administered through state energy offices.

Also, you can find information about how to install solar energy systems on your school via the Schools Going Solar initiative, which is sponsored by DOE. Your EnergySmart Schools representative can guide you to these resources, or you can find them through the DOE energy hotline and the EnergySmart Schools website.

www.eren.doe.gov/energysmartschools

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Energy Smart Schools
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